SCIENCE:

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JOHN MICHELS, Editor.

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THE advantages of having a good public library in a large city are so obvious that it appears incomprehensible that the most important city in the United States is practically without such an institution.

The city of New York appears to have been fortunate in being made the recipient of munificent testimentary gifts for the purpose of founding a great public library suited to the needs of such a community, but also unexceptionally unfortunate in the disposition of the funds so bequeathed.

The Astor Library contains a collection of books which have been most judiciously selected to form the nucleus of a good public library, and one peculiarly suited to the needs of those residing in such a city as New York. Unfortunately, the trustees of the library permit its use only between the hours of 10 A.M. and 4 P. M., thus practically shutting out the majority of those who desire to consult the literary treasures it contains.

Of the Lennox Library, recently bequeathed to the citizens of New York, it may be premature to speak; possibly in time its doors may be open to the public; but under what conditions and restrictions can only be conjectured from the eccentric formalities of the past.

Thus with the Astor Library open for a few fashionable hours during the day, and the Lennox Library closed altogether, the public of New York finds itself after four o'clock, P. M., daily, and during the whole of Sunday, without a free public library. Such a state of things is not creditable to the largest and most important city in this Republic, and should not continue a day longer.

The good policy of establishing a public library for New York city, which shall be under the full control of the city authorities, is daily becoming more apparent, and we trust the time is not distant when the wishes of the people in this respect may be fully realized.

A letter will be found in another page of this issue relating to our notice of Dr. Beard's lecture on "Mesmeric Trance." The writer is not correct in stating that we threw a doubt on the genuineness of the "phenomena, as a whole," as on the contrary our remarks questioned the integrity of the "subjects" produced by Dr. Beard. These men and boys, since the lecture in question, have been nightly performing the same tricks in a room on Sixth avenue, the advertisement for which is headed "Marvels and Fun of Mesmerism." The propriety of bringing such "subjects" before the New York Academy of Sciences, may well be questioned, and so far from accepting their performances as genuine exhibitions of the phenomena of Hypnotism, we apprehend the closest scrutiny should be made to test the genuineness of their acts.

Professor Hitchcock admits that he and others observed what appeared to us as evidence of collusion between Dr. Beard and his subjects, but objects to our having pointed out these facts, without having first permitted Dr. Beard to give his explanation of them. This amounts to a request to suppress all criticism, except that controlled by the person criticised, which appears to us one of the least inviting methods of arriving at the truth.

The subject is one of undoubted interest, and as we do not wish to prejudice the question, we defer any detailed reply to Professor Hitchcock's letter until others have had an opportunity of expressing their views. Our columns will be open to any correspondent who can add to our knowledge of this subject, or who can give a rational explanation of the phenomenon of Hypnotism.

SCIENTIFIC SOCIETIES IN WASHINGTON.

THE ANTHROPOLOGICAL SOCIETY.

NEW OFFICERS ELECTED AND A CHANGE OF LOCATION AGREED UPON.

The Anthropological Society met at the Smithsonian Institution on the evening of January 18th, Major J. W. Powell, the president, in the chair. The following new members were elected: Dr. A. F. A. King, Dr. William Lee, and Mr. Ivan Petroff for active membership, and Mr. J. C. Tache and B. B. Redding for corresponding membership. It being the evening of the annual election, no papers were read. A motion to remove from the present location to the lecture-hall of the National Medical College of the Columbian University was introduced by a committee of the council, and adopted by the society.

The election of officers to serve during the ensuing year resulted as follows: President, Major J. W. Powell; vice-presidents, Colonel Garrick Mallery, Dr. George A. Otis, Professor O. T. Mason, Dr. H. C. Yarrow; corres-

ponding secretary, C. C. Royce; recording secretary, Lester F. Ward; treasurer, J. Howard Gore; curator, Dr. W. J. Hoffman; council, President J. C. Welling, Professor E. A. Fay, Dr. J. Meredith Toner, Mr. F. A. Seely, Mr. Miles Rock, Mr. H. L. Thomas.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

On the first of December last, another society was organized for the study of the Biological sciences which, after completing its organization, elected the following officers for the ensuing year: President, Theodore Gill; vice-presidents, C. V. Riley, J. W. Chickering, Henry Ulke, Lester F. Ward; secretaries, G. Browne Goode, Richard Rathburn; treasurer, Robert Ridgway; council, George Vasey, O. T. Mason, J. H. Comstock, and Drs. Schafer and A. F. A. King. Professor S. F. Baird was elected an honorary member. Dr. Frank H. Baker, Mr. H. H. Birney and Mr. C. W. Scudder were elected to active membership. Professor L. F. Ward read a paper entitled "The Flora Columbiana of 1830 and 1880," in which a comparison was made between the lists of plants recorded as growing in the District of Columbia in 1830 in Brereton's "Flora," and the lists as now known to the botanists of the District. Mr. Ulke spoke of the occurrence in the District of many species of beetles, before known only in Alaska and other remote localities. Professor Jordan read a paper on "The Salmon of the California Coast," which contained many new and important facts regarding their habits and economic value. The annual address will be delivered at the next meeting by Professor Theodore Gill. A paper was also read by Professor Tarleton H. Bean on "An Excursion to the Northern Coast of Alaska."

CHEMICAL SOCIETIES.

The January *Conversazione* of the American Chemical Society was held at the rooms of the Society on Monday evening, January 17. The Vice-President, Dr. Albert R. Leeds, of the Stevens Institute, exhibited a new modification of Dinitro-orcine and certain of its salts. These salts were originally prepared by Professor Leeds at his own laboratory in the course of his investigations of Hyponitric Anhydride in organic substances.

Specimens of Dibenzole and Diphenyle were also exhibited by the same gentleman. Several of the members took advantage of the occasion to visit the laboratory and see the recently patented electrical inventions of Dr. O. Lugo.

The next and regular meeting will take place on the first Monday of February, the 7th prox.

The Chemical Society of Paris announces that among the vice-presidents, according to the constitution, the president shall be chosen from the following gentlemen; M. M. Grimaux, Salet and Berthelot, and that the Council nominates M. M. Grimaux and Salet; therefore M. Berthelot will remain as vice-president during 1881, and in consequence of the regretted decease of M. Personne, M. Berthelot will be the only occupant of that office.

The German Chemical Society at their annual re-union increased the dues of the non-resident members from 15 to 20 marks. This action has been in contemplation for several years, and has now been definitely settled.

M. B.

THE French Association for the Advancement of Science is to hold its next meeting in the city of Algiers, on the 14th of April. The people and authorities of the city are making preparations to give the Association a fitting welcome, and liberal appropriations have been made by the Council for organizing the meeting, to entertain the members and their friends.

THE UNITY OF NATURE.

BY THE DUKE OF ARGYLL.

V.

ON THE TRUTHFULNESS OF HUMAN KNOWLEDGE CONSIDERED IN THE LIGHT OF THE UNITY OF NATURE.

But another nightmare meets us here—another suggestion of hopeless doubt respecting the very possibility of knowledge touching questions such as these. Nay, it is the suggestion of a doubt even more discouraging—for it is a suggestion that these questions may probably be in themselves absurd—assuming the existence of relations among things which do not exist at all—relations indeed of which we have some experience in ourselves, but which have no counterpart in the system of Nature. The suggestion, in short, is not merely that the answer to these questions is inaccessible, but that there is no answer at all. The objection is a fundamental one, and is summed up in the epithet applied to all such inquiries—that they are anthropomorphic. They assume authorship in a personal sense, which is a purely human idea—they assume causation, which is another human idea—and they assume the use of means for the attainment of ends, which also is purely human. It is assumed by some persons as a thing in itself absurd that we should thus shape our conceptions of the ruling power in Nature, or of a Divine Being, upon the conscious knowledge we have of our own nature and attributes. Anthropomorphism is the phrase employed to condemn this method of conception—an opprobrious epithet, as it were, which is attached to every endeavor to bring the higher attributes of the human mind into any recognizable relation with the supreme agencies in Nature. The central idea of those who use it seems to be that there is nothing human there; and that when we think we see it there, we are like some foolish beast wondering at its own shadow. The proposition which is really involved when stated nakedly is this: that there is no Mind in Nature having any relation with, or similitude to, our own, and that all our fancied recognitions of intellectual operations like our own in the order of the Universe are delusive imaginations.

The denial of what is called "The Supernatural" is the same doctrine in another form. The connection may not be evident at first sight, but it arises from the fact that the human mind is really the type of the Supernatural. It would be well if this word were altogether banished from our vocabulary. It assumes that we know all that "Nature" contains, and that we can pronounce with certainty on what can and what cannot be found there. Or else it assumes that Nature is limited to purely physical agencies, and that our own mind is a power and agency wholly separate and distinct from these. There might indeed be no harm in this limitation of the word if it could be consistently adhered to in all the terms of any argument involving its use. We are all quite accustomed to think of Man as not belonging to Nature at all—as the one thing or Being which is contradistinguished from Nature. This is implied in the commonest use of language, as when we contrast the works of Man with the works of Nature. The same idea is almost unconsciously involved in language which is intended to be strictly philosophical, and in the most careful utterances of our most distinguished scientific men. Thus Professor Tyndall, in his Belfast address to the British Association, uses these words: "Our earliest historic ancestors fell back also upon experience, but with this difference, that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of Nature, but from what lay much closer to them—the observation of men." Here Man is especially contradistinguished from Nature; and accordingly we find in the next sentence that this idea is connected with the error of seeing our-

selves—that is, the Supernatural in Nature. "Their theories," the Professor goes on to say, "accordingly took an anthropomorphic form." Further on, in the same address, the same antithesis is still more distinctly expressed thus: "If Mr. Darwin rejects the notion of creative power acting after human fashion, it certainly is not because he is unacquainted with the numberless exquisite adaptations on which the notions of a supernatural artificer is founded." Here we see that the idea of "acting after human fashion," is treated as synonymous with the idea of a supernatural artificer; and the same identification may be observed running throughout the language which is commonly employed to condemn Anthropomorphism and the Supernatural.

The two propositions, therefore, which are really involved in the thorough-going denial of Anthropomorphism and the Supernatural are the following: 1st, that there is nothing above or outside of Nature as we see and know it; 2nd, that in the system of Nature, as thus seen and known, there is no mind having analogies with our own.

Surely these propositions have been refuted the moment the definition of them has been attained. We have only to observe, in the first place, the strange and anomalous position in which it places Man. As regards at least the higher faculties of his mind, he is allowed no place in Nature, and no fellowship with any other thing or any other Being outside of Nature. He is absolutely alone—out of all relation with the Universe around him, and under a complete delusion when he sees in any part of it any mental homologies with his own intelligence, or with his own will, or with his own affections. Does this absolute solitariness of position as regards the higher attributes of Man—does it sound reasonable, or possible, or consistent with some of the most fundamental conceptions of science? How, for example, does it accord with that great conception whose truth and sweep become every day more apparent—the Unity of Nature?

How can it be true that Man is so outside of that unity that the very notion of seeing anything like himself in it is the greatest of all philosophical heresies? Does not the very possibility of science consist in the possibility of reducing all natural phenomena to purely mental conceptions, which must be related to the intellect of Man when they are worked out and apprehended by it? And if, according to the latest theories, Man is himself a Product of Evolution; and is therefore, in every atom of his body and in every function of his mind, a part and a child of Nature, is it not in the highest degree illogical so to separate him from it as to condemn him for seeing in it some image of himself? If he is its product and its child, is it not certain that he is right when he sees and feels the indissoluble bonds of unity which unite him to the great system of things in which he lives?

This fundamental inconsistency in the Agnostic philosophy becomes all the more remarkable when we find that the very men who tell us we are not one with anything above us, are the same who insist that we are one with everything beneath us. Whatever there is in us or about us which is purely animal we may see everywhere; but whatever there is in us purely intellectual and moral, we delude ourselves if we think we see it anywhere. There are abundant homologies between our bodies and the bodies of the beasts, but there are no homologies between our minds and any Mind which lives or manifests itself in Nature. Our livers and our lungs, our vertebræ and our nervous systems, are identical in origin and in function with those of the living creatures round us; but there is nothing in Nature or above it which corresponds to our forethought, or design, or purpose—to our love of the good or our admiration of the beautiful—to our indignation with the wicked, or to our pity for the suffering and the fallen. I venture to think that no system of philosophy that has ever been taught on earth lies under such a weight of antecedent improbability; and this improbability increases in direct proportion to the success of science in tracing the Unity of Nature, and in showing step by step how its laws and their results can be brought more and more into direct relation with the Mind and intellect of Man.

Let us test this philosophy from another point of view, and see how far it is consistent with our advancing knowledge of those combinations of natural force by which the system of the physical Universe appears to be sustained.

We may often see in the writings of our great physical teachers of the present day reference made to a celebrated phrase of the old and abandoned school of Aristotelian physics—a phrase invented by that old school to express a familiar fact—that it is extremely difficult, if not absolutely impossible, to produce a perfect vacuum—that is to say, a space which shall be absolutely empty. The phase was this: "Nature abhors a vacuum." It is now continually held up as a perfect example and type of the habit of thought which vitiates all true physical reasoning. Now let us observe what this error is. As a forcible and picturesque way of expressing a physical truth—that the difficulty of producing a vacuum is extreme, that Nature sets, as it were, her face against her doing it—the phrase is a good one, and conveys an excellent idea of the general fact. Sir W. Grove says of it, that it is an "aphorism, which, though caviled at and ridiculed by the self-sufficiency of some modern philosophers, contains in a terse though somewhat metaphorical form the expression of a comprehensive truth." But there is this error in the phrase (if indeed it was or ever could be literally understood)—that it gives for the general fact a wrong cause, inasmuch as it ascribes to the material and inanimate forces of Nature, whose simple pressures are concerned in the result, certain dispositions that are known to us as affections of Mind alone. In short, it ascribes to the mere elementary forces of Matter—not to a living agency using these as tools, but to mere material force—the attributes of Mind.

Now it is well worthy of remark, that, so far as this error is concerned, the language of physical science is full of it—steeped in it; and that in this sense it is chargeable with a kind of anthropomorphism which is really open to the gravest objection. To see Mind in Nature, or, according as Nature may be defined, to see Mind outside of Nature, acknowledging it to be Mind, and treating it as such—this is one thing—and this is the true and legitimate anthropomorphism which some physicists denounce. But to see Mind in material forces alone, and to ascribe its attributes to them—this is equally anthropomorphism, but a form of it which is indeed open to all the objections they express. This, nevertheless, is the anthropomorphism which gives habitually its coloring to their thoughts and its spirit to their language.

Let me explain what I mean by some examples. I will take, first, the theory of development, or the derivative hypothesis, which, as applied to the history of animal life, is now accepted by a large number of scientific men, if not as certainly true, at least as an hypothesis which comes nearer than any other to the truth. Whether that theory be true or not, it is a theory saturated throughout with the ideas of utility and fitness, and of adaptation, as the governing principles and causes of the harmony of Nature. Its central conception is, that in the history of organic life changes have somehow always come about exactly in proportion as the need of them arose. But how is it that the laws of growth are so correlated with utility that they should in this manner work together? Why should varied and increasing utility operate in the requisite direction of varied and increasing developments? The connection is not one of logical necessity. Not only can we conceive it otherwise, but we know it is otherwise beyond certain bounds and limits. It is not an universal law that organic growths arise in proportion to all needs, or are strengthened by all exertion. It is a law prevailing

only within certain limits; and it is not possible to describe the facts concerning it without employing the language which is expressive of mental purpose.

Accordingly, Mr. Darwin himself does use this language perpetually, and to an extent far exceeding that in which it is used by almost any other natural philosopher. He does not use it with any theological purpose nor in connection with any metaphysical speculation. He uses it simply and naturally for no other reason than that he cannot help it. The correlation of natural forces, so adjusted as to work together for the production of use in the functions—for the enjoyments and for the beauty—of life, this is the central idea of his system; and it is an idea which cannot be worked out in detail without habitual use of the language which is molded on our own consciousness of the mental powers by which all our own adjustments are achieved. This is what, perhaps, the greatest observer that has ever lived cannot help observing in Nature; and so his language is thoroughly anthropomorphic. Seeing in the methods pursued in Nature a constant embodiment of his own intellectual conceptions, and a close analogy with the methods which his own mind recognizes as "contrivance," he rightly uses the forms of expression which convey the work of Mind. "Rightly," I say, provided the full scope and meaning of this language be not repudiated. I do not mean that naturalists should be always following up their language to theological conclusions, or that any fault should be found with them when they stop where the sphere of mere physical observation terminates. But those who seek to remodel philosophy upon the results of that observation cannot consistently borrow all the advantage of anthropomorphic language, and then denounce it when it carries them beyond the point at which they desire to stop. If in the words which we recognize as best describing the facts of Nature there be elements of meaning to which their whole force and descriptive power is due, then these elements of meaning must be admitted as essential to a just conception and to a true interpretation of what we see. The analogies which help us to understand the works of Nature are not, as it were, foreign material imported into the facts, but are part of these facts, and constitute the light which shines from them upon the intellect of Man. In exact proportion as we believe that intellect to be a product of Nature, and to be united to it by indissoluble ties of birth, of structure, and of function, in the same proportion may we be sure that its organs of vision are adjusted to the realities of the world, and that its innate perceptions of analogy and resemblance have a close relation to the truth. The theory of Development is not only consistent with teleological explanation, but it is founded on teleology, and on nothing else. It sees in everything the results of a system which is ever acting for the best, always producing something more perfect or more beautiful than before, and incessantly eliminating whatever is faulty or less perfectly adapted to every new condition. Professor Tyndall himself cannot describe this system without using the most intensely anthropomorphic language, "The continued effort of animated nature is to improve its conditions and raise itself to a loftier level."

Again I say, it is quite right to use this language, provided its ultimate reference to Mind be admitted and not repudiated. But if this language be persistently applied and philosophically defended as applicable to material force, otherwise than as the instrument and tool of Mind, then it is language involving far more than the absurdity of the old mediæval phrase that "Nature abhors a vacuum." It ceases to be a mere picturesque expression, and becomes a definite ascription to Matter of the highest attributes of Mind. If Nature cannot feel abhorrence, neither can it cherish aspirations. If it cannot hate, neither can it love, nor contrive, nor adjust, nor look to the future, nor think about "loftier levels," there.

Professor Tyndall in the same address has given us an interesting anecdote of a very celebrated man whom the world has lately lost. He tells us that he heard the great Swiss naturalist, Agassiz, express an almost sad surprise that the Darwinian theory should have been so extensively accepted by the best intellects of our time. And this surprise seems again in some measure to have surprised Professor Tyndall. Now it so happens that I have perhaps the means of explaining the real difficulty felt by Agassiz in accepting the modern theory of evolution. I had not seen that distinguished man for nearly five-and-thirty years. But he was one of those gifted beings who stamp an indelible impression on the memory; and in 1842 he had left an enthusiastic letter on my father's table at Inverary on finding it largely occupied by scientific works. Across that long interval of time I ventured lately to seek a renewal of acquaintance, and during the year which proved to be the last of his life, I asked him some questions on his own views on the history and origin of organic forms. In his reply Agassiz sums up in the following words his objection to the theory of Natural Selection as affording any satisfying explanation of the facts for which it professes to account:—"The truth is that Life has all the wealth of endowment of the most comprehensive mental manifestations, and none of the simplicity of physical phenomena."

Here we have the testimony of another among the very greatest of modern observers that wealth—immense and immeasureable wealth—of Mind is the one fact above all others observable in Nature, and especially in the adaptations of organic life. It was because he could see no adequate place or room reserved for this fact in the theory of development that Agassiz rejected it as not satisfying the conditions of the problem to be solved. Possibly this may be the fault of the forms in which it has been propounded, and of the strenuous endeavors of many of its supporters to shut out all interpretations of a higher kind. But of this we may be sure, that if men should indeed ultimately become convinced that species have been all born just as individuals are now all born, and that such has been the universal method of creation, this conviction will not only be found to be soluble, so to speak, in the old beliefs respecting a creative Mind, but it will be unintelligible and inconceivable without them, so that men in describing the history and aim and direction of evolution, will be compelled to use substantially the same language in which they have hitherto spoken of the history of creation.

Mr. Mivart has indeed remarked in a very able work,[1] that the teleological language used so freely by Mr. Darwin and others is purely metaphorical. But for what purpose are metaphors used? Is it not as a means of making plain to our own understandings the principles of things, and of tracing amid the varieties of phenomena the essential unities of Nature? In this sense all language is full of metaphor, being indeed composed of little else. That is to say, the whole structure and architecture of language consists of words which transfer and apply to one sphere of investigation ideas which have been derived from another, because there also the same ideas are seen to be expressed, only under some difference of form. Accordingly when naturalists, describing plants or animals, use metaphorically the language of contrivance to describe the adaptations of function, they must use it because they feel it to be a help in the understanding of the facts. When, for example, we are told that flowers are constructed in a peculiar manner "in order that" they may catch the probosces of moths or the beaks of bees, and that this adaptation again is necessary "in order that" these insects should carry the fertilizing pollen from flower to flower, nothing more may be immediately intended by the writer than that all this elaborate mechanism does as a matter of fact attain

1. "Genesis of Species."

this end, and that it may fitly be described "as if" it had been arranged "in order that" these things might happen. But this use of language is none the less an acknowledgment of the truth that the facts of Nature are best brought home and explained to the understanding by stating them in terms of the relation which they obviously bear to the familiar operations of our own mind and spirit.

And this is the invariable result of all physical inquiry. In this sense Nature is essentialy anthropomorphic. Man sees his own mind reflected in it—his own, not in quantity but in quality—his own fundamental attributes of intellect, and, to a wonderful and mysterious degree, even his own methods of operation.

It is really curious and instructive to observe how even those who struggle hardest to avoid the language of anthropomorphism in the interpretations of Nature are compelled to make use of the analogies of our own mental operations as the only possible exponents of what we see. Let us look, for example, at the definition of Life given by Mr. Herbert Spencer. It is a very old endeavor to construct such definitions, and not a very profitable one: inasmuch as Life is only known to us as itself, and all attempts to reduce it to other conceptions are generally mere playing with empty words. But it is not without instruction to observe that Mr. Spencer's laborious analysis comes to this: "Life is the continuous adjustment of internal relations to external relations." Bare, abstract, and evasive of characteristic facts as this formula is, it does contain at least one definite idea as to how Life comes to be. Life is an "adjustment." This is a purely anthropomorphic conception, conveying the idea of that kind of co-ordination between different powers or elements which is the result of constructive purpose. I have already pointed out in a former chapter that all combinations are not adjustments. The whole force and meaning of the word consists in its reference to intentional arrangement. No combination can properly be called an adjustment if it be purely accidental. When, therefore, Life is represented as an adjustment, this is the mental image which is reproduced; and in so far as it does reproduce this idea, and does consciously express it, the formula has at least some intelligible meaning. If, indeed, it has any plausibility or approach to truth at all, this is the element in it from which this plausibillty is derived.

We may take another case. Mr. Matthew Arnold has invented a new phrase for that conception of a Divine Being which alone, he thinks, can be justified by such evidence as we possess. And what is that phrase? "The Eternal, not ourselves, which makes for righteousness." Surely whatever meaning there may in this artificial and cumbrous phrase is entirely derived from its anthropomorphism. An agency which "makes for" something—that something, too, being in the future, and being also in itself an abstract, moral, and intellectual conception—what can such an agency be conceived to be? "Making for" an object of any kind is a purely human image—an image, too, derived primarily not from the highest efforts of human Will, but from those which are represented in the exercises of the body, and the skill with which, in athletic contentions, some distant goal may be reached and won. Such is the attempt of a very eminent man to instruct us how we are to think of God without seeing in Him or in His word anything analogous to our own thought and work.

Nor is it wonderful that this attempt should fail, when we consider what it is an attempt to do—to establish an absolute separation between Man and Nature; to set up Man as something above Nature, and outside of it; and yet to affirm that there is no other Being, and no other Intelligence in a like position. And if anything can render this attempt more unreasonable, it must be the urther attempt to reach this result through science—science, the very possibility of which depends upon and consists in the possibility of reducing all natural phenomena within the terms of human thought, so that its highest generalizations are always the most abstract intellectual conceptions. Science is the systematic knowledge of relations. But that which perceives relations must be itself related. All explanations consist in nothing else than in establishing the relation which some order of external facts bears to some corresponding order of thought; and it follows from this truth, that the highest explanations of phenomena must always be those which establish such relations with the highest faculties of our nature. Professor Tyndall, in another part of his Belfast address, like many other writers of the present day, goes the length of saying that the great test of physical truth is what may be called its "representability,"—that is to say, the degree in which a given physical conception can, from the analogies of experience, be represented in thought. But if our power of picturing a physical fact distinctly be indeed an indication of a true physical analogy, how much more distinctly than any physical fact can we picture the characteristic workings of our own mental constitution. Yet these are the conceptions which, we are told, we are not to cherish, because they are anthropomorphic—or, in other words, because of the very fact that they are so familiar to us, and their mental representability is so complete.

Some, indeed, of our physical teachers, conscious of this necessary and involuntary anthropomorphism of human thought and speech, struggle hard to expel it by inventing phrases which shall as far as possible avoid it. But it is well worthy of observation that, in exact proportion as these phrases do avoid it, they become incompetent to describe fully the facts of science. For example, take those incipient changes in the substance of an egg by which the organs of the future animal are successively laid down—changes which have all reference to a purely purposive adaptation of that substance to the future discharge of separate and special functions. I have already referred[2] to the fact that these changes are now commonly described as "differentiations," an abstract expression which simply means the establishment of differences, without any reference to the peculiar nature of those differences, or their relations to each other and to the whole. But the inadequacy of this word to express the facts is surely obvious. The process of dissolution and decay are processes of differentiation as much as the process of growth and adaptation to living functions. Blood is differentiated just as much when, upon being spilt upon the ground, it separates into its inorganic elements, as when, circulating in the vessels, it bathes and feeds the various tissues of the living body. But these two operations are not only different, but absolutely opposite in kind, and there does not seem to be much light in that philosophy which insists on using the same formula of expression to describe them both. It is a phrase which empties the facts, as we can see and know them, of all that is special in our knowledge of them. It is possible, no doubt, by this and other similar artifices of language, so to deprive them—or at least to appear to deprive them—of their highest mental characters. More foolish than the fabled ostrich, we may try to shut our eyes against our own perceptions, or refuse to register them in our language—resorting, for the sake of evasion, to some juggleries of speech. "Potential existence" is another of those vague abstract conceptions which may be, and is, employed for a like purpose. It may be applied indiscriminately to a mere slumbering force, or to an unfulfilled intention, or to an undeveloped mental faculty, or to an elaborate preparation of foresight and design. If we desire to take refuge from the necessity of forming any

[2] "SCIENCE," Vol. I., p. 181.

distinct conceptions, such phrases are eminently convenient for the purpose, whilst under cover of them we may cheat ourselves into the belief that we have got hold of some definite idea, and perhaps even of an important truth.

All who are puzzled and perplexed by the prevalent teaching on these high matters should subject the language in which it is conveyed to a careful, systematic, and close analysis. It will be found to fall within one or another of these three classes:—First, there is the phraseology of those who, without any thought either of theological dogma or of philosophical speculation, are, above all things, observers, and who describe the facts they see in whatever language appears most fully and most naturally to convey what they see to others. The language of such men is what Mr. Darwin's language almost always is—eminently teleological and anthropomorphic. Next, there is the language of those who purposely shut out this element of thought, and condemn it as unscientific. The language of this class is full of the vague abstract phrases to which I have referred—"differentiation"—"molecular change"—"harmony with environment," and others of a like kind—phrases which, in exact proportion to their abstract character, are evasive, and fall short of describing what is really seen. Lastly we have the language of those who habitually ascribe to Matter the properties of Mind; using this language not metaphorically, like the old Aristotelians whom they despise, but literally—declaring that Mind, as we know it, must be considered as having been contained "potentially" in Matter; and was once nothing but a cosmic vapor or a fiery cloud. Well may Professor Tyndall call upon us "radically to change our notions of Matter," if this be a true view of it; for in this view it becomes equivalent to "Nature" in that largest and widest interpretation to which I referred at the close of the last chapter—viz., that in which Nature is understood as the "Sum of all Existence." But if this philosophy be true, let us at least cease to condemn, as the type of all absurdity, the old mediæval explanations of material phenomena, which ascribe to them affections of the mind. If Matter be so widened in meaning as to be the mother and source of Mind, it must surely be right and safe enough to see in it those dispositions and phenomena which are nothing but its product in ourselves.

The truth is, that this conception of Matter and of Nature, which is associated with vehement denunciations of anthropomorphism, is itself founded on nothing else but anthropomorphism pushed to its very farthest limit. It is entirely derived from and founded on the fact that mind, as we see it in ourselves, is in this world inseparably connected with a material organism, and on the further assumption that Mind is inconceivable or cannot be inferred except in the same connection. This would be a very unsafe conclusion, even if the connection between our bodies and our minds were of such a nature that we could not conceive the separation of the two. But so far is this from being the case, that, as Professor Tyndall most truly says, "it is a connection which we know only as an inexplicable fact, and we try to soar in a vacuum when we seek to comprehend it." The universal testimony of human speech—that sure record of the deepest metaphysical truths—prove that we cannot but think of the body and the mind as separate—of the mind as our proper selves, and of the body as indeed external to it. Let us never forget that Life, as we know it here below, is the antecedent or the cause of organization, and not its product; that the peculiar combinations of matter which are the homes and abodes of Life are prepared and shaped under the control and guidance of that mysterious power which we know as vitality; and that no discovery of science has ever been able to reduce it to a lower level, or to identify it with any purely material force. And, lastly, we must remember, that even if it be true that Life and Mind have some inseparable connection with the forces which are known to us as material, this would not make the supreme agencies in Nature, or Nature as a whole, less anthropomorphic, but greatly more; so that it would, if possible, be even more unreasonable than it is now to condemn man when he sees in Nature a Mind having real analogies with his own.

And now what is the result of this argument—what is its scope and bearing? Truly it is a very wide scope indeed—nothing less than this: that nothing in philosophy, in theology, in belief, can be reasonably rejected or condemned on the sole ground that it is anthropomorphic. That is to say, no adverse presumption can arise against any conception, or any idea, or any doctrine on the mere ground that it rests on the analogies of human thought. This is a position—purely negative and defensive though it be—from which we cannot be dislodged, and which holds under its destructive fire a thousand different avenues of attack.

But this is not all. Another result of the same argument is to establish a presumption the other way. All the analogies of human thought are in themselves analogies of Nature, and in proportion as they are built up or are perceived by Mind in its higher attributes and work, they are part and parcel of natural truth. Man—he whom the Greeks called Anthropos, because, as it has been supposed, he is the only Being whose look is upwards—Man is a part of Nature, and no artificial definitions can separate him from it. And yet in another sense it is true that Man is above Nature—outside of it; and in this aspect he is the very type and image of the "Supernatural." The instinct which sees this image in him is a true instinct, and the consequent desire of atheistic philosophy to banish anthropomorphism from our conceptions is dictated by an obvious logical necessity. But in this necessity the system is self-condemned. Every advance of science is a new testimony to the supremacy of Mind, and to the correspondence between the mind of Man and the mind which is supreme in Nature. Nor yet will it be possible, in the face of science, to revive that Nature-worship which breathes in so many of the old religions of mankind. For in exalting Mind, science is ever making plainer and plainer the inferior position of the purely physical aspects of Nature—the vague character of what we know as Matter and material force. Has not science, for example, even in these last few years, rendered forever impossible one of the oldest and most natural of the idolatries of the world? It has disclosed to us the physical constitution of the Sun—that great heavenly body which is one of the chief proximate causes of all that we see and enjoy on earth, and which has seemed most naturally the very image of the Godhead to millions of the human race. We now know the sun to be simply a very large globe of solid and of gaseous matter, in a state of fierce and flaming incandescence. No man can worship a ball of fire, however big; nor can he feel grateful to it, nor love it, nor adore it, even though its beams be to him the very light of life. Neither in it nor in the mere physical forces of which it is the centre, can we see anything approaching to the rank and dignity of even the humblest human heart. "What know we greater than the soul?" It is only when we come to think of the co-ordination and adjustment of these physical forces as part of the mechanism of the heavens—it is only, in short, when we recognize the mental—that is, the anthropomorphic—element, that the Universe becomes glorious and intelligible, as indeed a Cosmos; a system of order and beauty adapted to the various ends which we see actually attained, and to a thousand others which we can only guess. No philosophy can be true which allows that we see in Nature the most intimate relations with our intellectual conceptions of Space and Time and Force, but denies that we

can ever see any similar relation with our conceptions of purpose and design, or with those still higher conceptions which are embodied in our sense of justice and in our love of righteousness, and in our admiration of the "quality of mercy." These elements in the mind of Man are not less certain than others to have some correlative in the Mind which rules in Nature. Assuredly, in the supreme government of the Universe these are not less likely than other parts of our mental constitution to have some part of the natural system related to them—so related that the knowledge of it shall be at once their interpretation and fulfillment. Neither brute matter nor inanimate force can supply either the one or the other. If there be one truth more certain than another, one conclusion more securely founded than another, not on reason only, but on every other faculty of our nature, it is this—that there is nothing but mind that we can respect; nothing but heart that we can love; nothing but a perfect combination of the two that we can adore.

And yet it cannot be denied that among the many difficulties and the many mysteries by which we are surrounded, perhaps the greatest of all difficulties and the deepest of all mysteries concerns the limits within which we can, and beyond which we cannot, suppose that we bear the image of Him who is the source of life. It seems as if on either side our thoughts are in danger of doing some affront to the Majesty of heaven—on the one hand, if we suppose the Creator to have made us with an intense desire to know Him, but yet destitute of any faculties capable of forming even the faintest conception of His nature; on the other hand, if we suppose that creatures such as (only too well) we know ourselves to be, can image the High and the Holy One who inhabiteth Eternity. Both these aspects of the truth are vividly represented in the language of those who "at sundry times and in divers manners" have spoken most powerfully to the world upon Divine things. On the one hand we have such strong but simple images as those which represent the Almighty as "walking in the garden in the cool of the day," or as speaking to the Jewish lawgiver "face to face, as a man speaketh to his friend;" on the other hand we have the solemn and emphatic declaration of St. John that "no man hath seen God at any time." In the sublime poetry of Job we have at once the most touching and almost despairing complaints of the inaccessibility and inscrutability of God, and also the most absolute confidence in such a knowledge of His character as to support and justify unbounded trust. In the Psalms we have these words addressed to the wicked as conveying the most severe rebuke, "Thou thoughtest that I was altogether such an one as thyself."

And perhaps this word "altogether" indicates better than any other the true reconciliation of apparent contradictions. In the far higher light which Christianity claims to have thrown on the relations of Man to God, the same solution is in clearer terms presented to us. "Knowing in part and prophesying in part," "Seeing through a glass darkly," and many other forms of expression, imply at once the reality and yet partial character of the truths which on these high matters our faculties enable us to attain. And this idea is not only consistent, but is inseparably connected with that sense of limitation which we have already seen to be one of the most remarkable and significant facts connected with our mental constitution. There is not one of the higher powers of our mind in respect of which we do not feel that "we are tied and bound by the weight of our infirmities." Therefore we can have no difficulty in conceiving all our own powers exalted to an indefinite degree. And thus it is that although all goodness, and power, and knowledge, must, in respect to quality, be conceived of as we know them in ourselves, it does not follow that they can only be conceived of according to the measures which we ourselves supply.

These considerations show,—first, that the human mind is the highest created thing of which we have any knowledge, its conceptions of what is greatest in the highest degree must be founded on what it knows to be the greatest and highest in himself; and, secondly, that we have no difficulty in understanding how this image of the Highest, may, and must be, faint—without being at all unreal or untrue.

There are, moreover, as we have seen, some remarkable features connected with our consciousness of limitation pointing to the conclusion that we have faculties enabling us to recognize certain truths when they are presented to us, which we could never have discovered for ourselves. The sense of mystery which is sometimes so oppressive to us, and which is never more oppressive than when we try to fathom and understand some of the commonest questions affecting our own life and nature, suggests and confirms this representation of the facts. For this sense of oppression can only arise from some organs of mental vision watching for a light which they have been formed to see, but from which our own investigations cannot lift the veil. If that veil is to be lifted at all, the evidence is that it must be lifted for us. Physical science does not even tend to solve any one of the ultimate questions which it concerns us most to know, and which it interests us most to ask. It is according to the analogy and course of Nature that to these questions there should be some answering voice, and that it should tell us things such as we are able in some measure to understand. Nor ought it to be a thing incredible to us—or even difficult to believe—that the system disclosed should be in a sense anthropomorphic—that is to say, that it should bear some very near relation to our own forms of thought—to our own faculties of mind, and soul, and spirit. For all we do know, and all the processes of thought by which knowledge is acquired, involve and imply the truth that our mind is indeed made in some real sense in the image of the Creator, although intellectually its powers are very limited, and morally its condition is very low.

In this last element of consciousness, however—not the limitation of our intellectual powers, but the unworthiness of our moral character—we come upon a fact differing from any other which we have hitherto considered. It is not so easy to assign to it any consistent place in the unities of Nature. What it is and what it appears to indicate, must form the subject of another chapter.

PROGRESS OF BOTANICAL SCIENCE IN THE UNITED STATES.

By J. C. Arthur.

The sketch by Professor Bessey in the December *Naturalist* of the work in Botany done in this country during 1879 is very interesting, and offers an opportunity of comparing the present status of the Science in America with its progress elsewhere. The article shows which departments have been most cultivated, and indicates to some extent the thoroughness and value of the observations and researches. The principal activity was manifested in Descriptive and Systematic Botany, and that largely among Phanerogams and Ferns. Such examples as Mr. Watson's "Revision of North American Liliaceæ" and Dr. Gray's "Botanical Contributions" are of the highest scientific value. These are accompanied by others which are little, if at all, inferior. Large and elegant works like Eaton's "Ferns of North America," Meehan's "Native Flowers and Ferns of the United States," Goodale's "Wild Flowers of America,"

and Williamson's "Fern Etchings," are signs of the healthy growth of popular interest in the objects of the Science.

Among the lower orders of plants, systematic work has not been so vigorous. The literature is widely scattered, and of many of the groups is in a most disheartening chaotic state. The disentangling and critical arrangement of this matter is at present one of the most important services that could be rendered the student. The labor of consulting all the descriptions belonging to any one group is often very great, and is always accompanied with a doubt if complete success has been attained. Further perplexities are the unequal value of the material when found, and the difficulty of determining synonymy. Monographs of the groups are exceedingly desirable; but such exhaustive studies are not often made, and in lieu of them careful compilations, aided by as much investigation and verification as possible, are very useful. Professor Bessey's "Erysiphei," Mr. Peck's "United States Species of Lycoperdon," and Dr. Halsted's "American Species of Characeæ" are admirable examples of such contributions to the advancement of knowledge.

It is a law in the growth of a biological science that the objects with which it deals must be carefully identified and systematically described before much progress will be made in the recondite investigations of structure and development, and the relations to physical forces, or in the higher problems regarding the *rationale* of forms and processes. Every advancement in morphology and physiology, however, reacts upon classification and helps to establish it upon a more satisfactory basis. While systematic work is thus the very foundation of the science, it is only by following it up in the same zealous manner with anatomical and physiological researches that the science makes most substantial advancement.

It is manifestly the natural and wise thing for American botanists to collect herbaria and study floras till the species and their distribution are fairly known. For Phanerogams and Ferns this has been well accomplished, and approximately so for Mosses and Liverworts, but the Thalloyhytes (Algæ and Fungi) remain comparatively unknown. Not but what there is still room for excellent systematic work among Phanerogams, but that the stumps and stones and other obstacles in the field have been pretty fully cleared away and it is now a matter of plain cultivation, while the other departments of the science need earnest workers who are not afraid of difficulties, and are willing to clear up and cultivate single handed as large areas as possible.

In the article cited, the Professor feels called upon to apologize for the neglect of Anatomy and Physiology during 1879. He says:—"While we may regret that so much of the field has been so sadly neglected in our country, we should remember that, as a rule, our botanists are overloaded with other duties which render it often impossible for them to command the time for making the necessary investigation." Admitting that the plea partly accounts for the inactivity, it still does not seem to touch the chief cause of the difficulty. It is rather to be ascribed to a lack of enthusiasm for these subjects. They have not yet come into vogue with lovers of the science: the tidal wave of laboratory and experimental Botany is yet but slightly felt; the problems seem new and strange, and just where and how to attack them appears obscure and uncertain. The work already done in these fields has mainly related to the means and accompanying phenomena of the fertilization of flowers. Some excellent papers have been published, although not lengthy. Histology, Embryology, and Physiology proper, however, appear almost without followers, judging from the results communicated. At the present time, Germany is the centre of the most active researches relating to the latter subjects, and France is not far behind.

In order to keep informed of the latest discoveries and results in the botanical world, an acquaintance with the journals in which they are announced is imperative. It is a trite saying in matters of daily life, that if one wishes to be "posted" he must read the papers. This applies even more forcibly to botanists, because their usual isolation deprives them of most other means of obtaining botanical news.

Among the most important exclusively botanical journals are the following: *Botanisches Centralblatt*, abstracts of the latest writings, and a full index, for all departments of the science; *Botanische Zeitung*, anatomy and physiology chiefly; *Flora*, general botany; *Pringsheim's Jahrbücker.*, physiological botany; *Hedwigia*, cryptogams; *Annales des Sciences Naturelles Botanique*, general botany, but with a large share of anatomy and physiology; *Bulletin de la Société Botanique de France*, general botany; *Journal of Botany*, largely systematic; *Grevillea*, cryptogams; and the two home journals—*Bulletin of the Torrey Club*, largely systematic; and *Botanical Gazette*, general botany, but inclined towards physiology. The first two of the list are weeklies; *Flora* is issued in thirty-seven numbers, and the others are monthlies. Beside these there are a large number of periodicals which devote considerable space to botanical matters, such as the *Quarterly Journal of Microscopical Science, Hardwicke's Science Gossip, American Naturalist, American Monthly Microscopical Journal*, etc. If one were confined to two, probably the *Botanische Zeitung* and the *Bulletin de la Société Botanique*, would prove the most satisfactory, presuming that the home journals are also taken, as a matter of course. Mr. Douglas, of Richland, N. Y., proposes to issue a translation of the *Zeitung*, for less than the subscription price of the original (but without the plates, we suppose). This laudable undertaking should receive substantial encouragement from English speaking botanists.

Probably there is no better indication of the beginning of a new era for American botany, than the changes made in the recent text-books. Dr. Gray's "Botanical Text-book" is expanded into four volumes, treating of the Morphological Structure of Phanerogams, Histology and Physiology, Cryptogams, and the natural orders of Phanerogams, respectively. The second volume is to be written by Dr. Goodale, and the third by Dr. Farlow. The first volume of the series has already appeared.

THE DETECTION OF STARCH AND DEXTRIN.

By Spencer Umfreville Pickering, B. A., Oxon.

In conducting some experiments in which it was necessary to ascertain the presence or absence of starch in a liquid containing various amounts of dextrin, the few facts here described were brought to light, and may, perhaps, be of sufficient interest to warrant their publication.

When a solution of starch which has been colored blue by the addition of iodine is heated, it is found that the temperature at which the color disappears varies with the intensity which it possessed before heating. Thus, for instance, 100 c. c. of a rather dark iodine-starch solution on being heated gradually in a flask became perfectly colorless at 58° C., and, on being cooled, showed a slight reappearance of color at 49° C., whereas an opaque blue solution did not lose its color till heated to 99° C., and became visibly colored again when cooled to 63° C. Similarly variable results were obtained by experimenting on iodine-starch solutions in sealed tubes, the temperatures of reappearance being much more constant (generally about 50° C) than those of disappearance; this no doubt is due to the fact that, the stronger solutions having been heated to a higher temperature than

the weaker ones in order to effect the disappearance, a greater quantity of the iodine present in them would have been converted into hydriodic acid, and this would tend to an equalization of the amounts of iodine present on cooling in the various cases. Owing to this conversion of iodine into hydriodic acid, the solutions on cooling, as might be expected, are considerably lighter than they were before heating, and their intensity naturally depends to a great extent on the rapidity with which they have been cooled; even a very weak iodine-starch solution which has been heated may be made to re-assume its color if cooled very quickly.

The amount of starch which may be recognized by means of the iodine reaction varies, of course, with the bulk of liquid operated upon. Using about 200 c.c. the weakest solution which gives an easily discernable blue tint in a beaker contains about 0.0001 per cent. of starch, while if small quantities are examined in a test-tube this percentage must be doubled in order that the color may be rendered visible. The green color which is noticed when a large quantity of iodine is added to a weak solution of starch, appears to be due simply to the combination of the proper yellow color of the free iodine with the blue color of the iodine-starch.

When two weak solutions of iodine, to one of which some starch has been added, are exposed to the air in an uncovered beaker, the iodine in both cases disappears entirely in the course of a few days, but more slowly from the solution which contains the starch; hence the iodine which disappears (owing partially to its volatilization into the air and partially to its hydrogenation) seems to be retained to a certain extent by the presence of starch. The presence of iodine has a reciprocal action in the preservation of starch. A solution of starch, which, in a few days, is converted into dextrin, may be preserved unaltered for a long time—possibly for an indefinite time, if an excess of iodine is present in it.

When a sufficient quantity of iodine is added to a solution of dextrin, a deep brown color is produced; the colored compound which is here present is in a state of true solution, whereas in the case of starch it will, as is well known, settle entirely to the bottom of the liquid in deep blue flocks, leaving the supernatant solution quite colorless, and these flocks on agitation are disseminated again so as to form an apparent solution. The dextrin reaction with iodine is not nearly so delicate as that of starch; the weakest solution which gave any discernable color on being tested contained 0.005 per cent. of dextrin, and in this case the color could only be detected by using about 200 c.c. of the solution, and comparing the color with that of some iodine solution of the same strength as that to which the dextrin had been added.

With starch, the first drop of iodine which is added produces a permanent coloration. With dextrin, however, this is not the case; the color produced by the first drops disappears instantly and entirely. A considerable quantity must be added before a moderately permanent color is produced, and the reaction, owing to which the iodine disappears in this way, will continue for six or seven days. Whether the dextrin disappears or not at the same time has not been ascertained, although it seems most probable that it should do so.

When a solution of iodine-dextrin is heated, the color becomes lighter and gradually disappears, as in the case of iodine-starch, but the temperature at which this disappearance takes place is considerably lower. An opaque brown solution on being heated in a flask became colorless at about 81° C., and, on cooling, regained its color with considerable diminution in intensity) at 64° C. A solution of one-quarter the strength of the preceding one lost its color at 52°, and regained it on cooling at 34° C.; here also, as in the case of iodine-starch, we find that the colored principle does not become colorless at any particular temperature, but its disappearance is dependent on its original intensity.

The dextrin usually met with in commerce contains a considerable amount of starch, which, however, may be entirely converted into dextrin by prolonged heating at 140° to 160° C for several hours, after which it gives the pure brown reaction with iodine above mentioned.

When iodine is added in excess to a mixture of starch and dextrin, the colors produced are blue, violet, purple, claret, red-brown, or brown, according to the various proportions in which the two substances are present. When the iodine is added gradually to the mixed solutions the colors produced, both temporary and permanent, follow the same order as those above mentioned, the blue colors appearing first, and the red ones only on the addition of larger amounts of iodine. Conversely, when the colored solution is allowed to stand, the red tints disappear first, and the blue ones last. Obviously, therefore, the gradual addition of iodine affords an easy and delicate means of detecting starch in the presence of even a large amount of dextrin. Another way in which starch may be detected in similar cases, is to add an ample sufficiency of iodine to produce a permanent color, and then to heat the liquid; the brown iodine-dextrin is decomposed at a comparatively low temperature, while the blue iodine-starch remains till the heat is raised considerably higher, and again, on cooling, the blue tint reappears long before the brown or red tint does; even when there is not sufficient starch to yield satisfactory results by this method, it may often be detected by the liquid being of a more bluish tint after the heating than it was before it.

O. Knab (*Chem. Centr. Blatt*, 1872, 492) found that some dextrin which he had prepared by repeated (ten times) precipitation with alcohol gave the reaction of a mixture of dextrin and starch, and hence concluded that it still contained some of this latter substance. It appears superfluous, however, to raise an impure preparation to the dignity of a chemical compound by giving it a distinct name—dextrin-starch—as Knab does. On leaving a mixture of solutions of starch and dextrin for some days, Knab found that, whereas the addition of iodine had at first caused a deep blue coloration, after a time nothing but the red or brown color of iodine-dextrin was produced, and hence draws the somewhat startling conclusion that starch under the influence of dextrin is converted into dextrin. A simpler and more probable conclusion from these experiments would surely have been, that at the end of the few days during which his experiments lasted, the starch had suffered that spontaneous decomposition to which it is, as is well known, so prone, leaving in solution nothing which would give a coloration with iodine but the unaltered dextrin.

Dextrin and starch, it appears, give entirely different reactions with iodine; the former combines with the halogen to form a brown soluble substance, whereas the latter forms with it a deep blue insoluble body; and these two reactions are so distinct that presence of either of the reagents may be easily detected in a solution containing both of them.

The fact that the addition of iodine to dextrin produces only a transitory color at first, and that an excess of it is necessary to give a permanent tint, will, no doubt, explain the various discordant statements which exist as to whether any color is produced by the mixture of these two substances or not, and will probably render unnecessary the theory of there being two or three different dextrins, as proposed by Mulder and Griessmayer.

DETERMINATION OF THE FATAL DOSE OF CARBONIC OXIDE FOR VARIOUS ANIMALS.—Air containing 1-300th of its volume of carbonic oxide proved fatal to a dog when inhaled for fifty minutes. In another dog of the same size the fatal dose was 1-250th. A rabbit resisted various proportions up to 1-60th. A sparrow perished with 1-500th.—M. GREHANT.

MICROSCOPY.

The annual reception of the New York Microscopical Society will be held on Monday evening, February 14th, 1881, at the rooms of the New York Academy of Sciences, No. 12 West 31st street.

Microscopical preparations of great interest will be exhibited, and the Board of Managers extend a cordial invitation to all possessing microscopes to attend the meeting. We trust that those microscopists residing in the city, who are not members, will avail themselves of this opportunity to observe the many facilties this society offers for extending a knowledge of this branch of science. Microscopical Societies do not profess to teach, but students will find ample opportunities of having the best methods of preparation practically explained to them, and by associating with the members at the ordinary meetings, information on any point relating to microscopy can be readily obtained. The annual dues of this society amount to $5 a year. Cards of admission to the *soirée* can be obtained of Professor Hitchcock, 53 Maiden Lane, New York City.

ASTRONOMY.

DR. B. A. Gould, Director of the Cordoba Observatory, Argentine Republic, has been unanimously elected a corresponding member of the Paris Academy of Sciences in the section of Astronomy, to fill the place of the late Dr. Peters.

The Observatory of Dunecht, near Aberdeen, Scotland, has undertaken the important matter of informing the astronomical observers in the United Kingdom, by means of circulars through the mails, of such facts as must be immediately made known to be of use. It has already issued thirteen circulars, and promises to be of the greatest advantage to British Astronomers.

W. C. W.

REMARKABLE METEOR.

Whilst returning home on the evening of December 29, 1880, I observed a very brilliant and somewhat remarkable meteor. Having seen no observation of this meteor published, and as it may be of interest, I will give a description.

The night was just beginning to be dark enough for the principal stars to shine brightly, the sky being intensely clear, with a cold, cutting wind from the west, the thermometer being below zero. My attention was suddenly attracted by a brilliant light; looking hastily up, I observed the meteor. It was very white and brilliant, with a short train; there was no sensible disk. It started from near *δ Aquarii* and moved at a moderate speed, passing some four or five degrees south of Venus, and appearing fully twice as large as that planet. After passing Venus a short distance, it suddenly flared up as if an explosion had occurred. It immediately slackened its speed, and assuming the brilliancy of a dullish first magnitude star, it floated slowly down in a slanting direction toward the southwest horizon. I watched closely, expecting to see it sink behind the horizon. It sunk slower and slower until, at an elevation of not more than 2°, it disappeared suddenly.

From the moment of explosion until its disappearance it was the size of a dull yellowish first to second magnitude star. No explosion was heard. It was first seen at about R.A. 22h. 54m. south declination, about 15°, disappearing at about R.A. 19h. 44m. and 19° or 20° south declination. Its visible path was about 42°.

It remained visible for fully half a minute, the greater portion of the time being after the explosion. Time, 6 hours Nashville m. t. Did any other observer note this object? E. E. BARNARD.

NASHVILLE, TENN., *January* 19, 1881.

JUPITER.

THE RAPIDLY MOVING WHITE SPOT.

The white spot, described by me in "SCIENCE" (No. 24), having continued permanent up to the last observation of Jupiter, led me to investigate its history. Tracing backward through my note-book, I find observations at intervals of the same spot, the first observation being on June 26, 1880.

On account of its rapid motion and frequent variation of form I had at each observation failed to recognize the identity of the objects seen.

The spot has invariably borne the same relative position to a long sinuous rift in the northern part of the equatorial band. In 1879 a similar spot was observed, bearing then the same relative position to a similar rift. It is probable that the object seen in 1879 is identical with the present white spot.

My observations this year show a decided variation in the rotation period of this object. Its varying velocity is doubtless due to changes in its form. My sketches show it to be at times scarcely noticeable as a pale, tolerably well defined spot. At other times it is shown as a long curved brilliant spot with its head "tucked" under towards the south, apparently plowing the dusky material of the equatorial belt before it, and a well-defined luminous train following in its wake. A sufficient number of observations have not yet been obtained to decide under what form it attains its greatest velocity. It is likely some sort of violent action takes place in the spot, under the influence of which it becomes very white, increases its motion throwing off a luminous train and cleaving the matter composing the great equatorial "river" like a vessel scudding before the gale. The action in the spot then gradually becomes quiescent, its motion slackens and it drifts along shorn of its train and scarcely recognizable; remaining thus until the forces in it are again at work, when it will once more pursue its rapid course in all the glory of a streaming train. But a lack of observations leaves its times of greatest motion in doubt, and it may be that the motion is greater when its appearance is less conspicuous.

On December 31 this object was seen as a pale, well-defined spot without any train. It was slightly following —by about two or three minutes—the meridian of the following end of the great red spot, having, since the middle of November, made a complete circuit of the planet, and was once more passing the red spot.

At the next observation, January 7, it had left the red spot a considerable distance behind, coming to the middle of the disk one hour before the red spot was central, having passed that object at about the time predicted in "SCIENCE" (No. 24.)

From the observations of June 26, 1880, and January 7, 1881, I get a rotation period of 9h. 50m. 47s.; in this case the transit on June 26 was estimated from a sketch The observations of Nov. 22 and December 2 give a period of 9h. 50m. 19s. Transits of November 22 and December 29, give a period of 9h. 50m. 14s. Transits of November 22 and January 7 give 9h. 50m. 5s. An estimated transit on August 17 and observed transit of January 7 give for its rotation 9h. 50m. 9s. It makes a complete circuit of Jupiter, compared with the red spot, once in 45.08 days. If at any time it is seen passing the red spot it will in forty-five days go completely around the planet and back to the red object again, which would indicate a daily velocity of 6170 miles, or 257 miles an hour. E. E. BARNARD.

NASHVILLE, Tenn., *Jan.* 18.

DETECTION OF ALCOHOL IN ETHEREAL OILS.—A. Drechsler employs, as reagent, a solution of 1 part potassium bichromate in 10 parts nitric acid of sp. gr. 1.30. Alcohol, if present, is at once betrayed by the pungent odor of ethyl nitrite.

CORRESPONDENCE.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

RELIEF TO THE JEANNETTE.

To the Editor of "SCIENCE:"

In compliance with your request concerning my views of the present probable status of the *Jeannette*, and especially the subject of a relief party to be sent to her, I would state that not desiring to renew at length the reasons set forth in the New York *Herald*, of January 12th, I will confine myself mainly to the few but important motives which point to the necessity of such a step in so far as they concern the interest of science. The urgency of immediate succor has been so thoroughly dwelt upon by yourself and others interested, that it can receive but little addition at my hands; suffice to say that the greater majority of Arctic accidents to naval expeditions, which would demand assistance, are of a violent character, such as wreck, ice-pressure, besettal and abandonment, etc., and which show plainly that rescue here, like that in all other zones, must be immediate to be effective in such emergencies. Also the necessity of replenishing the weakened portion of DeLong's crew, should they have been unfortunate in securing a sufficient supply of fresh meat can not be too strongly presented, for such a circumstance might fatally compromise an otherwise successful termination of the voyage, and just at the critical period of the undertaking. In a scientific point of view the field entered by the *Jeannette*, and which would be entered by her relief ship (which should carry a full and complete scientific corps) is one of the most interesting character. Nearly all of the Arctic estuaries of the Atlantic, have been more or less covered by the scientist and their fields of geography, physical and otherwise, their geology and minerology, their fauna and flora and many other kindred and interesting sciences, form huge volumes in the many libraries accessible to the student of these various topics, but on the Pacific side the many branches of science there presented form a vast field of investigation and research almost yet untrodden. That Lieutenant De Long's expedition could circumscribe, even in outline, this great theatre of undeveloped scientific resources is clearly impossible, and there have been but few predecessors along his route to show anything of value to those most deeply interested.

Every civilized nation has taken a public pride in bringing to light all the scientific knowledge attainable, pertaining to its own domain and its adjacent waters, acknowledging defeat and chagrin where it has been left to those differing in blood and allegiance to accomplish. It is only the savage, the barbarian, and semi-civilized community, that can allow these peaceful invasions without patriotic mortification or national chagrin. The Pacific Polar Seas are adjacent to the colonies of our own country and those of Russia. The latter has no great seaports or readily available fitting points in her Pacific coast whence an expedition may sail. With us, on the contrary, our Occidental shores are studded with goodly sized cities, one of which for such a purpose is as perfect as any in the world. It is therefore the plain duty of America to harvest this field, at least, even if the grain must be sent abroad to be ground.

It has also been proposed to establish permanent stations in the Arctic for scientific purposes, all nations uniting, forming a grand international chain, whose united observations will settle many disputed, and probably bring forth and illustrate many new, theories in the science of these zones, especially in the domain of meteorology, where continuous observations are so essential. To cover the Alaskan coast would be the least that could be expected of us, and it is not at all doubtful but that the British American shores belonging more peculiarly to us, by reason of contiguity, than to Great Britain, by reason of colonial possession, would be partially assigned to us, at least in this scheme. The relief party sent to the *Jeanette* could found this little colony, herself make extended investigations, and subserve the purpose of humanity by rescuing or relieving an expedition of our own countrymen under our own flag.

In all cases of abandonment of vessels in Arctic waters, the scientific collections have necessarily been left, as nothing should burden the retreating crews, except absolute necessaries, in a race for life where every ounce of weight is of vital importance, and these collections are almost as good as lost when only feebly represented by their descriptions and imperfect sketches. Such has been the fate of so many collections, rendering the voyage, in a scientific sense, almost *nil*, so that the rescue of an expedition, with such facilities of research, should meet the hearty encouragement of every scientist of America.

F. SCHWATKA.

GOVERNOR'S ISLAND, NEW YORK HARBOR,
January 29, 1881.

HYPNOTISM.

To the Editor of "SCIENCE:"

I doubt not that many of the readers of "SCIENCE" who attended the recent lecture of Dr. Beard, before the New York Academy of Sciences, will be surprised to read the article which you have published on page 13, Vol. II. It is not my purpose in this letter to defend the position of Dr. Beard in this matter, for if he deems it necessary I have no doubt he will give a satisfactory explanation of the few minor points which have given rise to your suspicions as to the genuineness of the phenomena. The circumstance of the person who was rendered deaf, and who was roused from his trance in the surprising manner which you describe, likewise aroused some questions in my own mind, as did also one or two other experiments; but instead of selecting these as a basis for adverse criticism, it has seemed to me more in accord with scientific methods to first inquire what explanation of them Dr. Beard himself can give.

The question before the general scientific world is not whether we can pick out single points for criticism, but whether the phenomena, as a whole, are genuine. The study of trance is not one with which most of us can claim familiarity, and although it is one which, more than almost any other, demands very special training to enable a person to profitably investigate the phenomena, we seldom find a person, even among scientific men, who has not his own ideas or theories or explanations about it. For this reason, Dr. Beard's careful study of the subject probably will not be fully appreciated during this, in some respects, conservative generation. Physical phenomena may be tested and abstruse hypotheses framed to explain them, and the world will accept the explanation; but in matters of trance, the clearest demonstrations cannot shake deep-seated beliefs, or convince unreasoning skeptics.

What has been the attitude of scientific men in the past toward this subject? It has been one of disbelief and nothing more. It is true that many of the phenomena (not all of them) have been known for many years. Your statement, however, that "nearly all our present knowledge of the subject dates from Braid's book" was directly contradicted by Dr. Beard in his lecture. Your assertion is only true of the phenomena. Dr. Beard's object was not to give an amusing exhibition of the phenomena of trance before a scientific body, but to explain them; the experiments being merely illustrative of the subject. I have still another criticism to make. You have assumed that "two of the subjects were evidently trained performers, if not professional actors." Admitting this

mere supposition, to be true, what possible bearing can it have upon the result? Why should not professional actors be as good subjects as any other persons? This objection seems to me about on an equality with some others which I have heard, *e. g.*, that all the subjects were trained to perform to suit the occasion. Your assertion that "the subjects of Dr. Beard are selected from the nervous classes of our population," is in direct contradiction to the doctor's declaration. In no sense can I regard your criticism as quite fair. Moreover, you have neglected to mention two of the most convincing demonstrations of the reality of the phenomena,—I refer to the extraction of two teeth from one subject, and the application of actual cautery to another. The opinion seems to be very common that the phenomena of mesmeric trance cannot be genuine unless all persons can be brought under its influence. A very little reflection will show that this is an erroneous opinion. There is much more that might be said upon the subject, but my purpose is only to correct the erroneous impressions which I am sure your article will give to many readers. I hope the columns of "SCIENCE" will be held open for a free discussion of these phenomena. R. HITCHCOCK.

To the Editor of "SCIENCE:"

In Dr. Spitzka's suggestive "Notes on the Anatomy of the Encephalon, etc.," in "SCIENCE," No. 29, occurs the following passage:

"Now, the third ventricle, as shown by Hadlich and Wilder, extends over the entire thalami."

I regret to be obliged to make a correction. The passage contains two distinct statements: the one, that the third ventrical extends over the entire thalami, and the other that such was shown to be the case by Hadlich and myself.

Since upon this point—as upon all others presented in the article—no exact references are given, I will not speak now of Hadlich's views; but no such statement has ever been made by me, and I am at a loss to understand how Dr. Spitzka can have gained that impression. On the contrary, my paper "On the Foramina of Monro in the Domestic Cat," read at the Boston meeting of the A. A. A. S., but not yet published, included an expression of my belief that, in the cat, the dorsal limit of the third ventricle on each side corresponds with the *Habena*, (the so-called "peduncle of the pineal body,") along which the *Endyma* (the lining membrane of the ventricles), is reflected from the mesial surface of the thalamus toward the opposite side. Hence, only the mesial aspect of each thalamus is "in the third ventricle," the remaining and much larger part of the surface being wholly extra-ventricular. BURT G. WILDER.

ITHACA, N. Y., *January* 26, 1881.

BOOKS RECEIVED.

BULLETIN No. 3 of the Illinois State Laboratory of Natural History at Normal, Ill., is a pamphlet of 160 pages, containing papers by the Director of the Laboratory, Prof. S. A. Forbes, on the following subjects: On some Interactions of Organisms; The Food of Fishes; Acanthopteri; On the Food of Young Fishes; The Food of Birds; Notes on Insectivorous Coleoptera. Likewise a brief but significant paper—Notes upon the Food of Predaceous Beetles, by Mr. F. M. Webster, who has independently come to the same conclusion as Prof. Forbes that the Carabidæ, in place of being exclusively insectivorous as is generally supposed, can, and in fact do, derive considerable sustenance from grains, grasses, and other vegetable substances.

The instructiveness and practical as well as scientific value of the researches which form the basis of these papers may be inferred from their titles, and from Prof. Forbes' well known accuracy and enthusiasm. But they are also very interesting and entertaining reading, and will thus be more apt to reach the minds of many who would otherwise fail to profit by the stores of information they contain. It would be well for other states to make the slight provision required for carrying on similar investigations into the food habits of the Birds, Fishes and Insects found within their limits.

B. G. W.

CHEMICAL NOTES.

DETECTION OF IODINE IN BORMINE AND METALLIC BROMIDES.—A few drops of the bromine in question are placed in a small porcelain capsule, 30 c.c. of a solution of potassium chlorate, saturated in the cold, are added, and the liquid is boiled till colorless. The solution is then poured into a test-tube, allowed to cool, mixed with a few drops of a solution of morphine sulphate and a little chloroform. If the chloroform takes a violet color, iodine is present in the sample. The morphine solution is prepared by dissolving 0.5 grm. morphine in an excess of dilute sulphuric acid, and diluting to 50 c.c. In examining potassium bromide the solution is mixed with 2 or 3 drops of pure bromine water, and a few c.c. of a cold saturated solution of potassium chlorate, and further treated as above. —A. JORISSEN.

DETERMINATION OF SULPHUR IN IRON PYRITES.—On oxidizing pyrites with nitric acid and precipitating the sulphuric acid from the ferriferous solution, slightly acidified with hydrochloric acid, there is always obtained a barium sulphate, contaminated with iron, and still the results were too low. The following process is, therefore, adopted: 1 grm. pyrites was mixed in a large covered crucible with 8 grms. of a mixture of equal parts potassium chlorate, sodium carbonate, and sodium chloride. The crucible is heated at first gently so as to dry the contents, which are afterwards melted at a high temperature. The mass when cold is treated with boiling water, and the solution together with the deposit is introduced into a measuring-flask of 200 c.c. filled up, filtered, and the sulphuric acid is determined in aliquot parts, say 50 c.c. The insoluble residue does not retain any sulphuric acid. In this manner the use of nitric acid is evaded. The decomposition of the potassium chlorate is complete.—BERNHARD DENTECON.

CONTRIBUTION TO ELECTROLYSIS.—L. Schucht describes the electrolytic determination of uranium, thallium, indium, vanadium, palladium, molybdenum, selenium, and tellurium. For qualitative analysis he uses a strong test-glass, 10 to 12 c.m. high, and 1.5 c.m. wide, fitted with a cork coated with paraffin. Two platinum wires, 1½ m.m. in thickness, pass through the cork down to the bottom, and are connected above the cork with the polar wires of the battery by means of small binding screws. This decomposition tube may be held in a wooden clamp. After the current has passed through the solution to be analyzed for ten to fifteen minutes, the stopper with the wires is drawn out, without interrupting the current, and the deposited metal is determined by its color, lustre, solubility in acids, &c. The manner of decomposition and the slight or strong evolution of gas is noticed. The solution is completely precipitated, rendered alkaline, and again electrolysed, after the wires have been cleansed. Copper is recognised by its color, mercury by the precipitated globules, nickel and cobalt by their lustre and sparing solubility in acids, zinc and cadmium by their color and solubility in potassa. The formation of peroxides is characteristic for lead, silver, bismuth, thallium, manganese. Bismuthic acid is gradually formed, whilst the peroxides of lead, silver, and thallium are deposited at the beginning of the precipitation. Silver peroxide dissolves in ammonia with liberation of nitrogen. The decomposition of the alkalies and alkaline earths is best effected in a U-tube. The hydroxides of the latter are separated in a voluminous form; those of calcium and magnesium in white crusts. The hydroxides of barium, strontium, and the alkalies dissolved on the negative wire. *Berg-und Hütten Zeitung*, 39, 121.